DOCUMENT RESUME

ED 050 818 PS 004 680

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TITLE Measuring Differential Development in Young Children.
PUB DATE 7 Feb 71
NOTE 10p.; Paper presented at the Annual Meeting of the American Educational Research Association, New York, New York, February 7, 1971

EDRS PRICE EDRS Price MF-$0.65 HC-$3.29
DESCRIPTORS Age Differences, Analysis of Variance, *Cognitive Development, *Intellectual Development, *Measurement Instruments, *Preschool Children, *Research Problems
IDENTIFIERS Ivanov Smolensky Procedure

ABSTRACT

The purpose of this study was to investigate the Ivanov-Smolensky procedure as an effective clinical device for the assessment of cognitive development in children under four years old. This procedure, expressly developed for assessing development in children with limited verbal skills, minimizes some of the research problems associated with young children since it requires only that a child respond to simple verbal commands and colored lights by squeezing a rubber bulb. Four groups of children (n=27), varying in age and IQ, were formed to test the sensitivity of the procedure to detect differential development. It was expected that if the procedure was sensitive, superior performance would be shown in the form of an increase in regulatory control with increased levels of development. Performance scores were submitted to analysis of variance and then multivariate analysis. Results showed that the Ivanov-Smolensky procedure has promise as a research device. (AJ)

MEASURING DIFFERENTIAL DEVELOPMENT IN YOUNG CHILDREN

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INTRODUCTION

Researchers are confronted by a two-fold problem when attempting to assess the development of young children. One part of the problem has been the availability of sensitive and reliable instruments for assessing early cognitive development. This is due to the fact that young children, especially those less than five years of age, are neither patient enough nor do they have the verbal facility to cope with anything but the simplest of tasks. Such tasks are superficial, and are usually not predictive of a child's intellectual performance. The second part of the problem relates to the nature of the young child as a subject. Young children tend to respond more as a function of some response biases than as a function of the meaning of the stimulus problem. For example, there are color-form preferences, position preferences, idiosyncratic response strategies, etc. The consequence of this problem is that a child's response may not be indicative of his cognitive development but merely a behavioral artifact.

An early reliable assessment of cognitive development is particularly important for the identification of deficits which may be remediable with early intervention. An example in which the early identification of

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delayed cognitive development might be critical is suggested by recent evidence reported by Heber (Heber, Dever and Conry, 1968). He found that certain groups of disadvantaged children, particularly those whose mothers have an IQ of 75 or below, from the age of three show a slow but steady decline from a normal IQ to the retarded level of their mothers. Early detection could, in this case, lead to early intervention, which might help to mitigate whatever depressing effects are involved in this intellectual decline.

Thus, the problem that remains is one of trying to index the cognitive development of children less than four years of age. We have been working with such a group of very young children. In order to circumvent some of the problems of research with this population and still measure the differential development of two groups of young children, we attempted the use of a technique employed extensively by Luria (e.g., 1963) and other Russian workers. This technique, called the Ivanov-Smolensky procedure, does not bind the child either to single designative or recognition responses but still allows for a demonstration of differential cognitive development. The procedure requires merely that a child respond to simple verbal commands and colored lights by squeezing a rubber bulb. It was expressly developed for assessing development in young children with limited verbal skills and minimizes some of the research problems associated with young children. Russian researchers report having considerable success with its use, although replication attempts in this country have not been entirely supportive (e.g., Jarvis, 1968).

According to the Luria schema, there are developmentally related differences in the ability to regulate motor responses elaborated to certain verbal commands. These differences are manifested as response patterns which are peculiar to different levels in the developmental sequence, varying as a function of age and/or the intellectual development of the child. Our intention in this study was therefore to investigate this technique, in a well-controlled and well-instrumented procedure, in an effort to develop the Luria, Ivanov-Smolensky procedure as a clinical device for the assessment of cognitive development.

A population of children that is participating in an early education project was uniquely suited to a test of the Luria notions. The experimental group had participated in a daily nursery school program almost since birth, and on the basis of their (standardized test) IQ scores were developmentally in advance of a comparison group of non-stimulated control children.

Using this population, four groups of children, varying in age and IQ, were formed to test the sensitivity of the Ivanov-Smolensky procedure to detect differential development. The design was a 2 x 2 factorial design. The children (27 in all) were divided into Low and High age groups (29.6 and 39.9 months, respectively) and Low and High IQ groups (93.9 and 130, respectively). The design of the study thereby provided a basis for testing Luria's notions regarding the differential development of regulatory control, both as a function of age and intellectual development. It was expected that if the Ivanov-Smolensky procedure was sensitive to differential development,

superior performance would be shown in the form of an increase in regulatory control with increased levels of development.

Apparatus: A modified Ivanov-Smolensky procedure was used. Each child was shown a series of red and blue lights, displayed through a milk-glass screen. The manipulandum was a rubber bulb, connected by way of a pressure transducer to a polygraph. Each response made by an S was recorded automatically and provided a record of the response onset, duration and amplitude. All stimulus presentations and interval times were controlled by instrumentation.

Procedure: Each child was seated in front of the display screen and his hand placed on the rubber bulb. Then each S was simply told to listen to what E said. E waited approximately three seconds after stimulus onset before giving the verbal command. The command "SQUEEZE" was given if the stimulus was positive (S^d) or "DON'T SQUEEZE" if the stimulus was negative (S^{Δ}). A series of tasks was given to each S including a preliminary Acquisition Task (S^d only), followed by a Discrimination Task (S^d and S^{Δ}); a Reversal Task (S^d and S^{Δ} reversed); and an Extinction Task (same as Reversal, but no reinforcement).

Results and Discussion:

The frequency of response data for each of the four tasks was submitted to an analysis of variance. There were two sets of data: (1) frequency of responses correctly made; and (2) frequency of responses correctly inhibited. The analyses of variance revealed significant effects only for frequency of responses correctly made,

and only for the Acquisition Task (see Figure 1). In this case older children were superior to younger children ($p < .01$) and High IQ children were superior to Low IQ children ($p < .01$). A significant ($p < .05$) interaction effect revealed that both High IQ groups were superior to either of the Low IQ groups. The fact that only Acquisition Task showed differential performance effects and only for the ability to respond correctly suggested one or both of two things: (1) that the Acquisition procedure had not been extended sufficiently in the early tasks; and/or (2) that the inhibitory process is inadequately developed at these early ages.

The second set of data submitted for analysis to a multivariate analysis of variance* consisted of the intensive measures (response onset, duration and amplitude) for both correct responses and incorrect responses. Only the response amplitude data for correct responses showed consistent significant differences between the groups. The significantly ($p < .001$) greater response amplitudes made by the older children is consistent with earlier research (e.g., Birch, 1966) (see Figure 2). However, this finding is easily attributable to sheer physical differences and is not a satisfactory test of the Luria hypothesis. On the other hand, a major finding was the significantly ($p < .005$) lower amplitude by the High IQ group (see Figure 3). In this case, since physical differences are minimized, the finding of lower response amplitude can be taken as an indication of an increase in response economy with increasing intellectual development, which is consistent with the Luria hypothesis.

In summary, it was felt that there is promise for the Ivanov-Smolensky procedure as a research device. If it is to be used as an early screening device, the sensitivity of the technique must be increased. This probably can be accomplished by applying it to a wider range of populations varying in intellectual development.

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FOOTNOTE

*The data was submitted for analysis to a multivariate analysis of variance computer program. The program has among its many options the provision for unequal numbers of observations in subclasses. Further, an analysis phase provided for analysis of selected subsets of variables from the original input set. The computer program is titled "FINNVER 4" (Finn, Version 4) by the University of Wisconsin Computing Center, and is the program mainly developed by Jeremy D. Finn of the Department of Educational Psychology, the State University of New York at Buffalo.

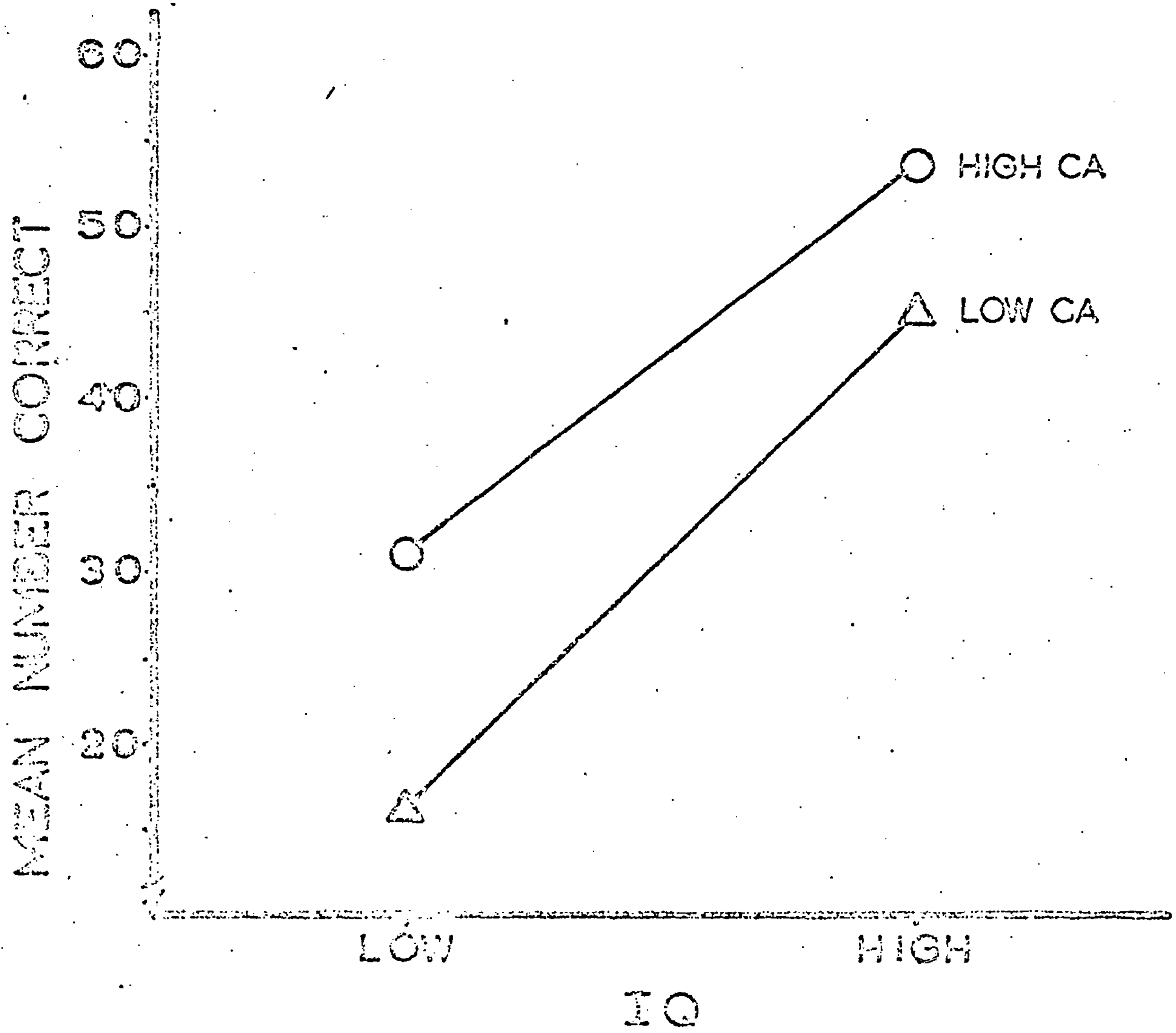

Figure 1

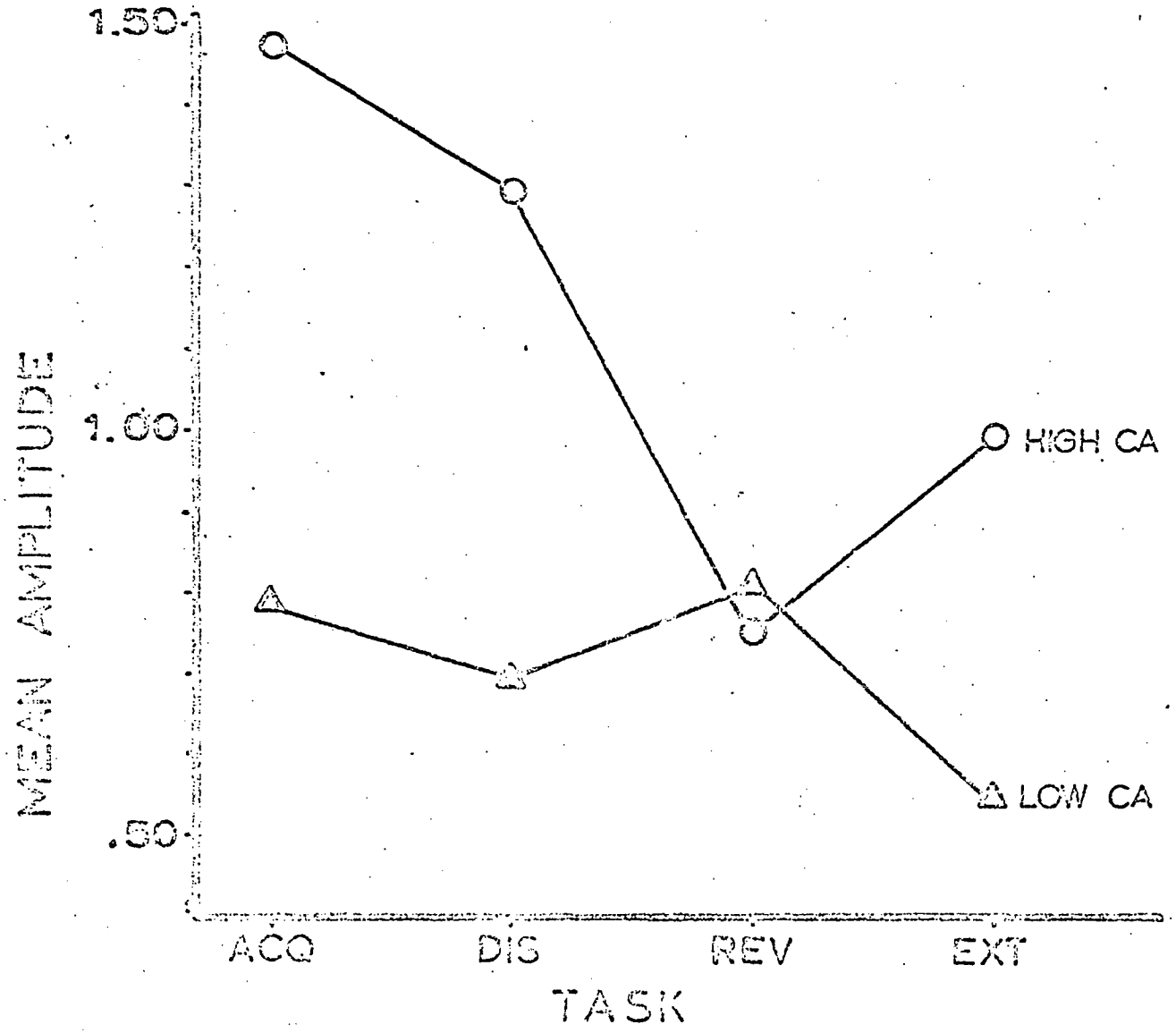

Figure 2

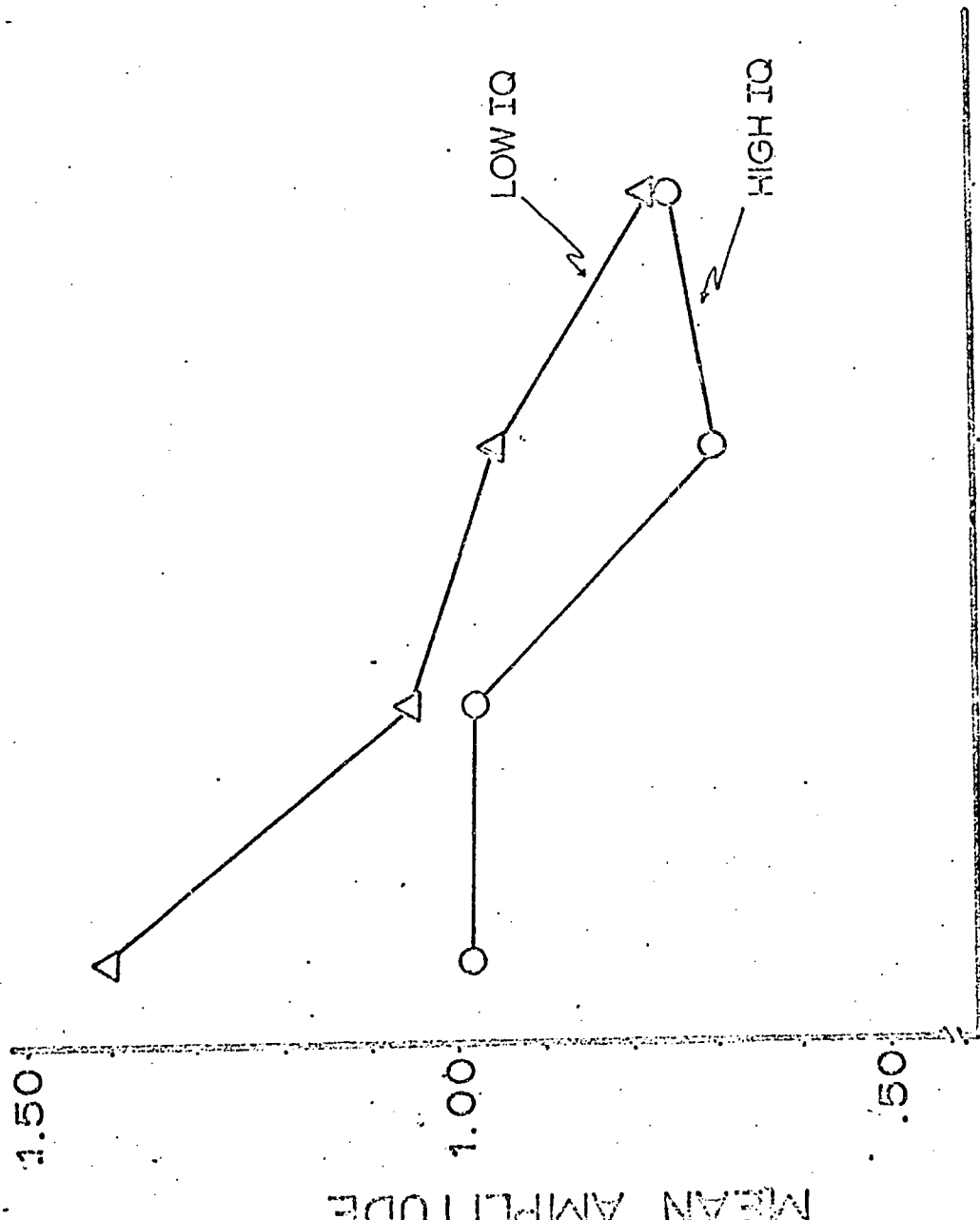

Figure 3

Table

SUMMARY OF SIGNIFICANT FINDINGS FROM ANALYSES OF ALL DATA

I. Frequency of responses correctly made:

Acquisition: High CA superior to Low CA
High IQ superior to Low IQ
High IQ, High and Low CA superior to Low IQ, High and Low CA

Discriminations)
Reversal) No significant sources of variance
Extinction)

II. Frequency of responses correctly inhibited:

Acquisition)
Discrimination) No significant sources of variance
Reversal)
Extinction)

III. Intensive properties of correct responses:

A. Response Time:
Unordered increase in extinction for all groups
B. Duration:
No significant sources of variance
C. Amplitude:
High CA showed greater amplitude than Low CA
High IQ showed lower amplitudes than Low CA

IV. Intensive properties of incorrect responses:

A. Response Time:
High CA responded slower in Extinction than Low CA
B. Duration:
No significant sources of variance
C. Amplitude:
No significant sources of variance